REMARKS

Response to Claim Rejections – 35 U.S.C. §112

Claims 1-24 and 36-46 were rejected under 35 U.S.C. § 112. The Examiner has requested an indication from the applicant regarding the intended scope of these claims in relation to 35 USC, § 112, sixth paragraph. It is intended that these claims not be drafted or interpreted in means-plus format under § 112, sixth paragraph. The Examiner has also stated, in point 2, that because it was unclear whether the claims fall under § 112, sixth paragraph that rejections under § 112, second paragraph have been entered. It is expected that this requested indication also addresses the rejections under § 112, second paragraph. It is therefore submitted that all pending claims are fully in compliance with § 112 and in condition for allowance.

The Examiner's acknowledgement that rejection of claims 1-16 under 35 USC § 112, second paragraph has been withdrawn is greatly appreciated. The Examiner's apology is also greatly appreciated, but not necessary. The subject matter of the present application is admittedly esoteric and the Examiner's efforts are appreciated.

The Examiner's statement in point 4 indicating that the claims recite limitations defining a scope beyond that which was disclosed by the specification is objected to, and will be addressed regarding the current § 112 rejection later in this Response.

Response to Claim Rejections – 35 U.S.C. §102

The Examiner's withdrawal of the claim rejections under § 102 in light of Karafillis are appreciated.

The Examiner has indicated a belief that the claim language does not adequately reflect the clarity and definiteness presented by admittedly persuasive arguments contained in the previous Response. The Examiner indicates that "[a]s the prior art shows, performing an iterative design process using finite element simulation is well known; thus a simulation that automatically switches from implicit to explicit once will commonly be used to switch two or more times." This is incorrect. Firstly, it assumes that the prior art teaches a simulation that automatically switches from implicit to explicit. This has not been established. As stated in the previous response, Karafillis does not teach a single version having both implicit and explicit functionality. Furthermore, Karafillis does not teach any switching (manual or automatic)

between implicit and explicit methodology (or vice versa) at any time, whether in its description of prior systems or the invention of Karafillis. The Examiner has stated on page 5 of the current Office Action that he found those arguments persuasive and that "Karafillis does not teach a single version having both an implicit and explicit functionality."

The Examiner's attention is drawn to a document entitled "Implicit Springback Calculation Using LSDYNA" by Bradley N. Maker ("Maker") submitted in an Information Disclosure Statement with this Response. The document states "[a] new capability has been added to LS-DYNA which allows automatic switching from dynamic explicit to static implicit analysis at the end of a forming simulation." Maker lines 11-12. Maker also does not teach "A method for performing a finite element simulation, the method comprising automatically switching between an implicit method and an explicit method two or more times during the finite element simulation."

Secondly, even given that automatic switching from dynamic explicit to static implicit at the end of a forming simulation is taught, it does not follow that "a simulation that automatically switches from implicit to explicit once will commonly be used to switch two or more times," as the Examiner has asserted. Switching between these two very complicated types of simulations is not a simple process. Nor is switching from explicit to implicit the same as switching from implicit to explicit. Switching from a first type of simulation to a second type of simulation requires that the output of the first is a usable input for the second type. The output from one type of simulation cannot simply be input into the other simulation. There was no device or method, available at the time of filing of the application, that performed "automatically switching between an implicit method and an explicit method two or more times during the finite element simulation" and thus it could simply not be done, contrary to the Examiner's assertion. Nor was there any publication available to that taught a "method comprising automatically switching between an implicit method and an explicit method two or more times during the finite element simulation."

This is explained in greater detail with regard to the current § 103 rejections, and the Examiner is kindly requested to refer to that section for more detail.

The Examiner's objection that the claims do not make reference to the "well known" implicit and explicit methods are addressed below regarding § 112, and the Examiner is kindly requested to reference those arguments regarding this point.

It is respectfully submitted that these remaining rejections should now be overcome, and that all pending claims are fully in compliance with both § 102 and § 112.

Claim Rejections – 35 U.S.C. §112

As an initial matter, it is respectfully submitted that all of the pending claims fulfill the requirement of 35 U.S.C. § 112. The claims are fully enabled and sufficiently definite for the reasons set forth below.

In satisfying the enablement requirement, an application need not teach, and preferably omits, that which is well-known in the art. Hybritech, Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367 (Fed. Cir. 1986); Lindemann Maschinenfabrik GMBH v. American Hoist and Derrick Co., 730 F.2d 1452, 1463 (Fed. Cir. 1984). How such a teaching is set forth, whether by the use of illustrative examples or by broad descriptive terminology, is of no importance since a specification which teaches how to make and use the invention in terms which correspond in scope to the claims must be taken as complying with the first paragraph of 35 USC 112 unless there is reason to doubt the objective truth of the statements relied upon therein for enabling support. Marzocchi at 439 F.2d 223.

"The test for definiteness is whether one skilled in the art would understand the bounds of the claim when read in light of the specification... If the claims read in light of specification reasonably apprise those skilled in the art of the scope of the invention, §112 demands no more." See e.g. Miles Laboratories, Inc. v. Shandon Inc., 5 F.3d 1464 (Fed. Cir. 1993).

One skilled in the art of modern finite element analysis would have no problem practicing the invention or understanding the bounds of any of the pending claims when read in the light of the specification, as explained below.

The following paragraphs address the Examiner's specific concerns.

Claims 1, 4-41 and 43-47 were rejected under 35 U. S.C, §112, first paragraph for failing to comply with the enablement requirement. The Examiner asserts that "the claims contain subject matter which was not described in the specification in such a way as to enable one skilled

in the art ... to make and/or use the invention." According to the Examiner, this is because "the claims are not limited to the disclosed and well-known explicit or implicit method."

The Examiner appears to suggest inclusion of the phrase "well known" to appear in the claims in order to make the scope of the claims commensurate with the disclosure. § 112 simply does not require such a thing. The Examiner's perceived disparity apparently stems from arguments in the prior Response that the implicit and explicit methods were indeed taught by the present application and are well known in the art.

It is respectfully submitted that the claims are not somehow broader than the specification because they do not recite "the well known implicit method" or "the well known explicit method." The claims are not broader in scope than the specification. The Examiner has misinterpreted the discourse of the last Office Action/Response to somehow unduly limit the specification. It is long-standing precedent that both the specification and claims are read from the point of view of one skilled in the art. Any prior arguments or discourse indicating that the implicit and explicit methods claimed and taught by the application were enabled and definite, because they are well known in the art, does mean that such methods are limited to a sub-set of implicit or explicit methods (only those that are well known). Furthermore, the examples given within the specification refer only to (preferred) embodiments of the claims, and those described embodiments should not limit the claims.

For example, many issued patent claims are new combinations of well known articles or steps. For example, a claim reciting a screw need not recite a "well known screw" simply because screws are well known in the art. If the Examiner is aware of any case law or procedure that dictates such a style of claiming, he is kindly requested to provide it.

Claims 1, 4-24, 36-41 and 43-47 were rejected under 35 U.S.C. §112, second paragraph for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Again, the Examiner has indicated that this is because it is unclear whether some of the claims should be interpreted as means plus function claims under § 112 paragraph 6. It is hereby submitted that they should not. Furthermore, the Examiner's assertions that the Applicant "is reading details from the specification into the claims" is hereby rebuked. In this, and the prior response, it has simply been advocated, according to long standing

precedent, that the claims are to be read in light of the specification. Therefore, in no way have "rights" under § 112, paragraph 6, been invoked.

Claim Rejections – 35 U.S.C. §101

Claim 1, 4-41 and 43-47 were rejected under 35 U.S.C. §101 as being directed to non-statutory subject matter.

All of the pending claims are directed to eligible subject matter. All of the claims, although they take different form and recite different aspects, are directed to finite element analysis systems. A finite element analysis system (and the pertinent and claimed computer system, computer readable media, data signal, and method) is a tool that is extremely useful and is not simply an abstract method that does not produce a tangible result. Every day engineers all around the world are using finite element analysis systems and methods to design safer, stronger, more affordable and generally better products. For example, any number of automotive engineers are using this tool to design cars that will better withstand crashes, get better fuel economy, or have less noise and vibration. Examples of parts (designed with the commercial embodiment of the present invention) have even been provided in the specification. Numerous other examples and uses can be provided upon request. It is asserted that this is precisely the sort of subject matter that the statute, and indeed the constitution itself, seek to advance and protect with the patent system.

While the Examiner's suggestions of additional claim limitations are appreciated, it is asserted that the pending claims are directed towards eligible subject matter as written, and are fully in compliance with 35 U.S.C. §101.

Claim Rejections – 35 U.S.C. §103

Claims 1, 4-41 and 43-47 were rejected under U.S.C. §103(a) as being unpatentable over LS-DYNA Keyword User's Manual, Version 950, dated May 1999, by Livermore Software Technology Corporation ("LS-DYNA") in view of U.S. Patent No. 6,478,991 to Mancosu et al. ("Mancosu") and further in view of U.S. Patent No. 5,609,342 to Peterson et al. ("Peterson").

The Examiner has stated that regarding claims 1, 14, and 25, LS-DYNA teaches "automatically switching from the implicit method to the explicit method during the simulation,"

but that it "does not explicitly recite automatically switching two or more times during the finite element simulation." This is incorrect. LS-DYNA teaches switching from the explicit mode to the implicit mode for a springback analysis, not the other way around. It does not teach the switch back to explicit or any switch from implicit to explicit.

Claim 1 recites "automatically switching between an implicit method and an explicit method two or more times." This requires at least one automatic switch from the implicit method to the explicit method (and one switch the other direction). **Such a switch is simply not taught by LS-DYNA, alone or in combination with Mancosu and Peterson.** Nor does it follow that switching from implicit to explicit modes can be taught either explicitly or inherently from switching from explicit to implicit modes. Although it might seem to the layperson that a switch from explicit to implicit is the same as switch from implicit to explicit, that is not the case. Each method requires certain parameters be present at the outset, and the switch therefore differs. This explanation is not offered or intended to change the scope of the claim, but simply to explain why LS-DYNA does not teach a switch from the implicit method to the explicit method, let alone "automatically switching between an implicit method and an explicit method two or more times."

LS-DYNA does not, inherently or explicitly, teach a switch to an explicit method because the variables needed for such a switch to take place are not taught by LS-DYNA as being stored. For example, variables defining the state of contact between different bodies are not stored (e.g. regions of contact, pressure distribution, friction and many other variables necessary for the numerical algorithms).

Numerical difficulties (non-linearities) in the treatment of bodies in contact is one of the most important situations where a temporary switch to an explicit time integration technique can be of great help. As stated above, since contact information is not stored (written to dynain), the switch cannot take place, and is therefore not taught by LS-DYNA.

The claimed "automatically switching between an implicit method and an explicit method two or more times" avoids the difficulties and limitations associated with terminating an ongoing simulation and using the output from the program to initiate a new model for a continuation of the analysis. This is simply not taught by LS-DYNA.

Furthermore, neither Mancosu nor Peterson teaches this. The Examiner has taken official notice that "an iterative design process using finite element simulation is well known in the art." This might be the case, but it still does not teach "a method for performing a finite element simulation, the method comprising automatically switching between an implicit method and an explicit method two or more times during the finite element simulation." One could perform ten iterations using a finite element simulation and still not switch "between an implicit method and an explicit method two or more times" manually, let alone automatically. Nothing about the iterative process implies a method comprising automatically switching. In fact, the iterative process is discussed as old and inefficient in the present application at page 21 line 4 to page 22 line 15, and is reproduced below for the Examiner's convenience.

> FIG. 4D shows a switching procedure that was manually generated using the present invention, as applied to a simulation of the formation of the Budd Complex Channel. In particular, FIG. 4D shows the manual switching scheme during the early stages of the Budd Channel forming simulation. This relatively simple switching scheme <u>required over ten trial-and-error simulations to develop, as the simulation times for each of the three switches had to be discovered</u>. Notice that the explicit method was used during the initial phase of the simulation, since a successful strategy which began with the implicit method could not be discovered by an experienced operator through a reasonable number of trial-and-error iterations.
>
> Although both the manual and the automatic switching methods provide advantages over conventional implicit only or explicit only simulation techniques, the automatic switching method provides several benefits over the manual switching procedure. For example, the automatic switching method produces a solution much faster than that which could be obtained using the manual switching procedure. Using the automatic switching method, the Budd Complex Channel simulation was completed in approximately 31 CPU hours on an IBM RS-6000/260 workstation computer. Using the manual switching procedure, a similar simulation was completed in approximately 27 CPU hours on the same computer. <u>However, the trial-and-error process of determining the switching scheme for the manual method involved more than ten failed simulations.</u> Thus the total simulation time using the manual switching method, including the trial-and-error process, was approximately ten times larger than the total simulation time using the automatic switching method. The cost savings measured in terms of man-hours required to conduct the simulation was even more significant, since the trial-and-error process required by the manual switching method was extremely labor intensive, and required an experienced operator, while the switching procedure generated by the automatic switching method ran successfully on the first attempt without intervention by the operator.

> Additionally, the automatic switching method produces a solution that is far more complex than that which could realistically be obtained using trial-and-error with the manual switching procedure. For example, the simulation of the Budd Complex channel using the automatic switching method involved fourteen switches between the implicit method and explicit method, while the manual switching scheme developed in over ten trial-and-error simulations included only three switches. FIG. 4D shows the switching scheme developed in the manual method, as compared to FIG. 4B for the automatic method. <u>A complex solution using fourteen switches would have been virtually impossible to discover by trial and error</u> using the manual switching procedure.

The Examiner further states that "by using such an iterative design process, a person of ordinary skill in the art using the software taught by LS-DYNA would perform a finite element simulation which automatically switches between an implicit method and an explicit method two or more times." This is simply not the case. Even if "the iterative process using finite element analysis is well known in the art," it does not mean and it does not follow that "a person of ordinary skill in the art using the software taught by LS-DYNA would perform a finite element simulation which automatically switches between an implicit method and an explicit method two or more times." The tool for doing so was simply not available before the present invention, and no publication discloses such a process.

Furthermore, in addition to not teaching all of the elements of the claims, it is highly doubtful that one of skill in the art would combine all three of these seemingly disparate references. These references are non-analogous art and each of them is very different from the others. Even though both Peterson and Mancosu mention finite element techniques, many things in the world have been designed using finite element techniques. It is respectfully submitted that this is not a sufficient motivation to combine these very different references. Both Peterson and Mancuso are not particularly relevant to the techniques of implicit-explicit switching. In fact, neither reference mentions either implicit or explicit integration techniques. Peterson is directed toward a Gas Shaft Seal with Flexible Converging Sealing Faces. Mancosu is directed towards a Method for Vulcanizing a Tire by Predetermining its Degree of Vulcanization. Neither is particularly relevant to designing better finite element analysis methods and systems. They are relevant to designing better gas shaft seals and tires.

Therefore, it is respectfully submitted that claims 1, 14, and 25, and all the claims that depend therefrom are not obvious in light of LS-DYNA, Mancosu, and Peterson.

Regarding claims 8-10, the Examiner has stated that "these trigger conditions are primarily functionally equivalent; they address difficulties inherent in an implicit method and invoke the explicit method to mitigate those difficulties." Even if this is so, it does not render the any of claims 8-10 obvious, and relies on the benefit of hindsight. Various difficulties are inherent in many types of problems, yet this in no way renders the different solutions developed to solve those problems and overcome those difficulties obvious. Each solution should be judged on its own merits. The fact that LS-DYNA teaches the use of smaller more manageable time steps or an artificial stabilization feature that retries portions of the simulation does not render claims 8-10, as reproduced below, obvious. Those are simply different solutions to different problems.

> 8. (Original) The method of Claim 1 further comprising monitoring a number of iterations performed using the implicit method and automatically switching from the implicit method to the explicit method if the number of iterations exceeds a predetermined threshold number.
>
> 9. (Original) The method of Claim 1 further comprising monitoring the internal energy of the model during iterations of the implicit method and automatically switching from the implicit method to the explicit method if the internal energy exceeds a predetermined threshold number.
>
> 10. (Original) The method of Claim 1 further comprising monitoring a length of time the explicit method has been running and automatically switching from the explicit method back to the implicit method if the length of time exceeds a predetermined threshold time period.

The combination of LS-DYNA, Mancosu, and Peterson does not teach all of the elements of dependent claims 8-10, for the reasons stated above.

Furthermore, to the extent claims 8-10 are rejected based upon the combination of LS-DYNA, Peterson, and Mancosu, the requisite motivation to combine the references is not present within the references, as discussed above.

Dependent claim 11 is allowable for all the reasons regarding claim 1, from which it depends. Furthermore, LS-DYNA, alone or in combination with Mancosu and Peterson does not teach "extending the termination time of the finite element simulation thereby forcing the finite element simulation to end using the implicit method." The Examiner's assertion that LS-DYNA

teaches concluding with an implicit simulation to perform springback analysis is not sufficient to render this limitation obvious, because the cited teachings do not address the limitations of the claim.

Claims 14-24 were rejected with the same reasons given for claims 1 and 4-13 and are allowable for the reasons given above regarding those claims, to the extent the claim language coincides.

Claims 25-35 were rejected with the same reasons given for claims 1 and 4-13 and are allowable for the reasons given above regarding those claims, to the extent the claim language coincides.

Claims 25-35 were rejected with the same reasons given for claims 1 and 4-13 and are allowable for the reasons given above regarding those claims, to the extent the claim language coincides.

Claim 36 was rejected with the same reasons given for claim 9 and is allowable for the reasons given above regarding claim 9, to the extent the claim language coincides.

Claims 37-41 and 43-46 were rejected with the same reasons given for claims 1 and 4-13 and are allowable for the reasons given above regarding those claims, to the extent the claim language coincides.

Claim 47 was rejected with the same reasons given for claims 8 and 10 and is allowable for the reasons given above regarding claims 8 and 10, to the extent the claim language coincides.

Therefore, it is respectfully submitted that all of the pending claims are novel and non-obvious, in light of LS-DYNA, alone or in combination with Peterson and Mancosu. All pending claims are therefore fully in compliance with the requirements of 35 U.S.C. § 103.

Information Disclosure Statement

An Information Disclosure Statement containing references cited in another related case is submitted herewith. It is submitted that all the pending claims are novel and non-obvious in light of the references contained therein.

Conclusion

Accordingly, it is believed that this application is now in condition for allowance and an early indication of its allowance is solicited. However, if the Examiner has any further matters that need to be resolved, a telephone call to the undersigned attorney at 415-318-1168 would be appreciated.

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